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THE BALSAM WOOLLY APHID SITUATION IN THE PACIFIC NORTHWEST 1/

This report evaluates three aspects of the balsam woolly aphid situation in the Pacific Northwest: (1) Current status of aphid research, (2) best management techniques to cope with the woolly aphid, and (3) need for further aphid research. Impetus for the evaluation was prompted by Mr. Donald Hopkins of the Washington State Department of Natural Resources. He wondered, in view of the significant aphid damage in subalpine fir stands and increased recreation pressure in these forests, if the problem might not warrant additional research emphasis.

The aim of this evaluation is to help determine whether an increased research effort is justified. Four entomologists were consulted about the opinions presented: R. L. Johnsey of the Washington State Department of Natural Resources, L. N. Kline of the Oregon State Board of Forestry, P. W. Orr of the Survey and Control Branch of the U. S. Forest Service and W. P. Nagel of Oregon State University. Discussions were held (Sept. 18) in the field, looking at infestations in the Willamette Pass area of Oregon.

Status of Research

Since serious research began some 10 years ago, 21 papers concerning the balsam woolly aphid have been published by cooperating entomologists and botanists in the Pacific Northwest. These papers range from descriptions of the problem to detailed analyses of how aphid infestations affect cell division in the cambium of infested trees. Some reports are aimed directly at the forester; others present findings which form the foundation for additional research.

At the peak of research activity, probably some 3 man-years of research time each calendar year was given to balsam woolly aphid investigations thoughout the Region. The effort since then has been somewhat reduced. Research time spent in the past year was about 1-1/2 man-years. Fundamental work on aphid-host relationships at Oregon State University accounted for 1 man-year; the remaining 1/2 man-year came from biological and damage trend studies at the Pacific Northwest Forest and Range Experiment Station.

Findings of studies thus far suggest that entomologists have taken research about as far as it is profitable. Biological studies have not revealed any weak links in the life cycle or behavior of the pest, and biological control, to which much hope was attached, has not produced results of much promise to date. A close look at the insect-host relationship, it seems is our best hope for the future. Accordingly, entomologists have reduced their effort on the aphid during the last few years. Unraveling the fundamental "whys" and "hows" in aphid-host relationships is a problem largely for plant physiologists and chemists.

1/ Statement prepared by Russel G. Mitchell, Pacific Northwest Forest and Range Experiment Station, Forest Service, for the October 12, 1967 meeting of the Northwest Pest Action Council in Portland, Oregon.

A good start on fundamental aphid-host relationship studies has been made through cooperative research between the Forest Service and the Botany Department at Oregon State University. In Canada,where efforts resembling a crash program against the aphid have been initiated, at least ten scientists are working on the problem. Five of these are working on fundamental studies regarding insect host relationships. Their findings will probably be applicable to the situation in the Pacific Northwest.

In the Experiment Station, future plans for aphid research are to continue studies of damage trends in infested areas and to extend, whenever and wherever possible, technical and financial support to universities interested in fundamental studies. These activities will probably involve no more than 1/4 man-year annually. The unknown that can affect plans is the biological control program. United States P.L. 480 funds are still being spent in Pakistan and India to investigate potential biological enemies of woolly aphids. If something of promise is found, the Station will be obligated to make liberations and evaluations.

Management Techniques to Cope with the Aphid

The aphid will continue to be a pest, but current trends suggest that damage can be minimized with cultural practices. However, management techniques will have to be tighter and in some instances changes in policy may be necessary.

Pacific silver fir, the most valuable of the attacked true firs in the Pacific Northwest, is fortunately the species that lends itself most easily to a management solution. Fundamentally, the principle is to (1) remove the susceptible trees from the susceptible areas and (2) replace them with non-susceptible species. This is a practical approach because aphid infestations are most serious at lower elevations where Douglas-fir grows as well or better than Pacific silver fir. Application requires that the site be modified by burning or some other cultural practice after the susceptible overstory has been removed. The aim is to eliminate residual silver fir and prepare a seed bed for Douglas-fir. If this is not done, silver fir will remain the principal species on the site; within a few years the woolly aphid will be a problem in regeneration.

Similarly, the solution for the aphid problem in grand fir is to replace the susceptible species with Douglas-fir. In lowland western valleys, where the damage is occurring, scarcely a tree over 40 years old has escaped infestation. Few trees die but most are severely deformed and growth is so reduced as to make them worthless. Because grand fir is generally a minor species in the stand and has no significant characteristics making it uniquely desirable, it is probably better to manage for Douglas-fir.

The balsam woolly aphid is most destructive in subalpine fir stands. But again the damage is greatest at the lower elevations and on the best sites. The problem is particularly acute in the lower elevation stream beds and around lakes--where recreation pressure is often heaviest.

Dead trees in established campgrounds are legal liabilities and often unsightly. But because the trees are valuable and accessible, they can be treated individually with insecticides. This procedure is probably more effective and cheaper than removing the trees after they are dead. Trees dying outside campgrounds can probably be ignored. They command little commercial value and are seldom missed by recreationists. Many people who travel the high-country trails feel that dead trees add a certain artistic touch to the landscape. In timberline areas, where subalpine fir is most revered, the aphid is not a problem.

Need for Further Research

The above recommendations are based on the assumption that forest managers will want to accept nature as it is and form management decisions accordingly. There is, however, an alternative position. The manager may wish to consider the possibility of not yielding to the pest; he may want to grow true fir as always, like the farmer who grows corn despite the many pest problems. If this is the case, a decision must be made on "where" and "how much" research is necessary to make the alternative possible.

It appears, after looking at all the possibilities, that the most fruitful line of future research would be basic investigation of insect-host relationships. The insect's relationship to its host is after all the fundamental reason for the problem. The balsam woolly aphid is not a pest in its native land, not because natural enemies keep it in check, but in a large part because European firs do not react to the aphid.

It is believed that any investigation into host-aphid relationships should be two-pronged. One thrust should be aimed at research giving results directly applicable to the solution of the problem, such as locating and propagating genetically resistant trees. The other angle of attack should be fundamental in nature, with the objective being to obtain complete understanding of the insect's mode of action and the host's response. This more basic approach would focus on such things as the reaction of host trees at the cellular level.

Knowing where to put our money is one thing, but to know how much research to buy, if any, is quite another problem. Balsam woolly aphid research in the Pacific Northwest would doubtless profit by having full time geneticists, chemists, and plant physiologists working on the problem. But it is debatable whether the value gained would be worth the effort. The principal difficulty in making a decision is that the problem has not been adequately evaluated. We only know that the balsam woolly aphid kills trees. We don't know precisely where it is killing them, how many are dying, and whether the objectives of land managers are such that we should care. Most of us who have discussed the problem believe that entomologists can take a leading role in saying "where" research should be directed, but the "how much"—decision is one that should be made largely by land managers. An important need in this respect is a thorough ground survey to pin down the location of all aphid infestations, incipient as well as epidemic. Next, an impact survey is needed. Lastly, the whole problem should be analyzed by an economist, with the management alternatives well in mind. Then we should know if an additional research effort would be worth the investment.